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Strontium Minerals From Wise County, Virginia

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Occurrence

Although strontium minerals are known to occur at several places in the United States, only recently have they been found in Virginia. One of the writers (RFP) first noticed celestite, $SrSO_4$, and calciostrontianite, $(Sr,Ca)CO_3$, in Wise County in July, 1958. A preliminary report on this occurrence was presented at the May, 1959, meeting of the Virginia Academy of Science, and has been published in abstract form (Pharr and Mitchell, 1959).

Both celestite and calciostrontianite occur along State Road 613 about one half mile east of East Stone Gap, Wise County, in a quarry in dolomite owned by Mr. G. H. Belton. The beds here consist of a succession of intercalated, fine-grained, medium-to-dark-gray, dolomites and magnesian limestones which are nearly horizontal. Eby (1923) has described the geology of the region and also gives a section of the formation at a place several yards west of the quarry. In his description there is no mention of strontium minerals. The quarry, which was opened in 1948, is now about 125 feet wide, 50 feet deep, and 60 feet high.

The strontium minerals are found in vugs in a stratum of thick-bedded dolomite approximately 16 feet above the floor of the quarry. In size the vugs range from less than ½ inch to over 10 inches across. The vugs are easily traced, and occur in a horizontal zone across the quarry. The vugs examined by the writers were rather barren of good material. They did contain etched celestite crystals and small globular calciostrontianite masses. Most of the better celestite crystals studied by the writers were collected by Mr. Belton and his son over a period of several years, and, although they probably came from the vuggy dolomite zone, their exact location in the quarry is not certain.

Description of the Celestite

Most of the celestite is pale-blue in color and occurs as well-developed crystals which average from ½ to ¾ inches in length. Crystals up to about 2 inches long occasionally were noted. Typical crystal shapes are illustrated in Figure 1.

In addition to the large bluish crystals, small glistening colorless celestite crystals, measuring between 1/16 and ⅛ inch, were also found associated with small calciostrontianite globules and small calcite scalenohedrons, on porous pieces of dolomite.

A fragment of blue fibrous celestite, resembling satin spar gypsum, was found loose in the quarry. The piece is tabular, measuring about

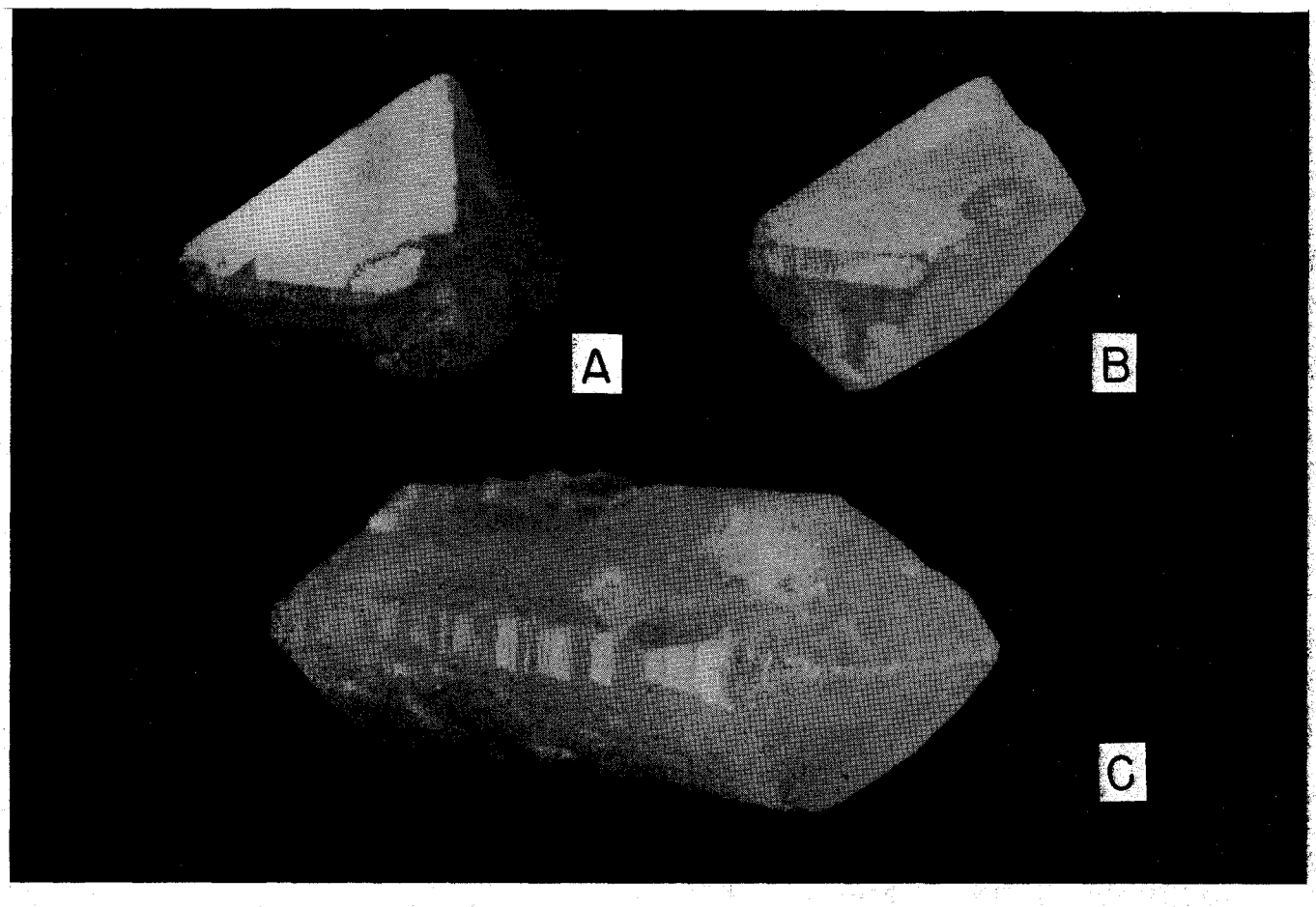

Figure 1-A, B, Celestite crystals from Wise County, Virginia. Approximately X2.5. C, Tabular celestite crystal from Wise County, Virginia. Approximately X2.5.

an inch across and ⅛ inch thick, and probably represents a cross-fiber vein.

Cleavable masses of blue and white celestite were also observed filling veins and vugs in the rocks of the quarry. One mass of blue celestite measures 2 by 4 by 5 inches. Also masses of very porous skeletal white celestite, evidently resulting from advanced corrosion of the material, were occasionally observed. Furthermore, from a study of thin sections of rocks from the quarry, microscopic euhedral crystals of celestite were noted to be imbedded in dolomite.

X-ray diffraction powder data for the celestite showed no significant departure from that of pure strontium sulfate, however, a semiquantitative spectrographic analysis of a specimen did reveal 0.15 percent CaO and 0.002 percent BaO.

Description of the Calciostrontianite

Calciostrontianite occurs intimately associated with celestite in the quarry, especially with celestite which is frosted or deeply corroded. Calciostrontianite forms vitreous to dull globular masses which possess an internal radial structure. The size of the globules are usually less than ½ inch in diameter. They vary in color from a light grayish-white to light buff. Bright pale-green to cream fluorescence is exhibited under long-wave ultraviolet light (3600 to 3650 A. U.). Some are smooth, but the majority of the globules are rough and are terminated by small acicular crystals. See Figure 2.

The presence of considerable amounts of calcium in the strontium carbonate was first suspected from the X-ray diffraction data, which departed considerably from those for pure material. Preliminary semiquantitative spectrographic analyses of fragments taken at random showed the content of CaO to vary from 7.5 to 15 percent. Quantitative spectrographic analyses of specially selected and cleaned material revealed 10.6 ± 1.0 percent CaO for a tan specimen, and 9.1 ± 1.0 percent CaO for a white specimen. Traces of Ba, Mg, Al, and Cu, listed here in the order of decreasing amounts, were also noted by

semiquantitative spectrographic analyses. The name calciostrontianite was introduced into the literature by Cathrein (1888) for a type of strontianite, from Brixlegg, Tyrol, which contains a considerable amount of calcium in addition to strontium. Up to 7.36 percent CaO was found in the Tyrol material. The name emmonite was given by Thomson (1836) to a material from "Massachusetts" (probably from New York, according to Palache, Berman, and Frondel, 1951) with nearly an identical amount of CaO. Although the name emmonite was introduced earliest, the writers prefer to use calciostrontianite.

Calciostrontianite globules occur attached to the large blue celestite crystals, especially in the vicinity of solution channels, or along seams where two crystals are joined. Masses of porous dolomite also contain globules of calciostrontianite attached to the walls of cavities. In this case tiny gemmy celestite crystals, as well as gemmy white calcite crystals, were associated with the dolomite cavities. Most evidence suggests that the calciostrontianite is secondary after celestite and was probably formed by the reaction of weak carbonic acid waters upon this sulfate.

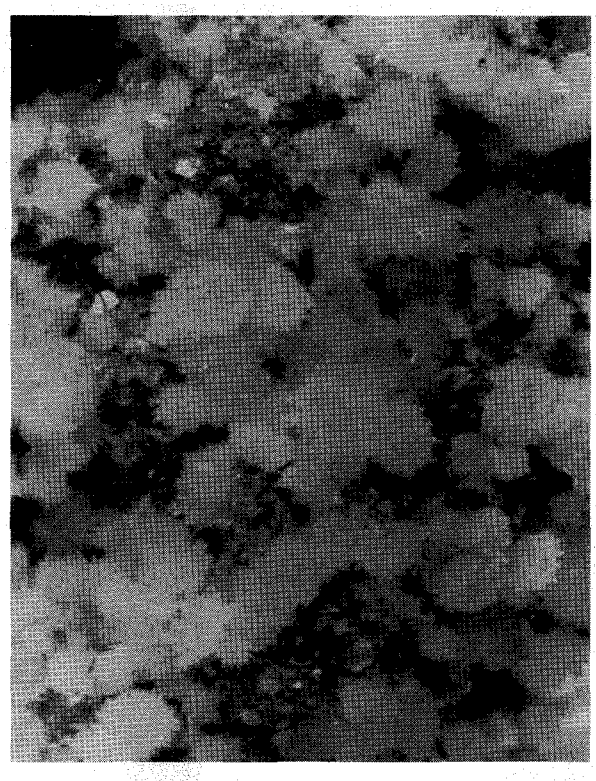

Figure 2—Calciostrontianite globular masses attached to porous dolomite. Some tiny celestite crystals are visible. X5.

Description of Associated Minerals

Numerous calcite crystals have been collected from the deposit. In general there are three types of crystals. The first of these, honey-yellow dogtooth spar, occurs in crystals from ½ to 1¼ inches in length, although crystals up to 2 inches in length were observed. Some of these crystals are badly etched and corroded. The situation of the crystals in the quarry is not known, since the material available for study was collected by the quarry operator. No yellow crystals were observed in the quarry by the writers. Neither celestite nor calciostrontianite were found associated with the yellow calcite. A second type of calcite is white dogtooth spar. These crystals are about ½ inch in length. Thirdly, small stubby calcite scalenohedrons, seldom larger than ¼ inch, were noted in association with calciostrontianite spherulites and small gemmy celestite crystals in cavities in the dolomite. In addition to crystals, calcite was also found in the form of Mexican onyx, filling some solution channels in the quarry rock.

Minor amounts of other minerals were found in the quarry rock. Occasionally cleavage masses of yellow-brown sphalerite, up to about ½ inch across, are in cavities associated with the strontium minerals. A light-purple paper-thin crusty material, on dolomite rock, was shown, by X-ray diffraction, to consist of a mixture of fluorite and dolomite. A dull bluish-green mineral filling seams in the dolomite was identified by X-ray diffraction as glauconite. X-ray studies of a black earthy material filling stylolitic seams in the quarry rock showed the presence of illite. A white efflorescent material, which had formed on dolomite, gave X-ray patterns for starkeyite ($MgSO_4 \cdot 4H_2O$) (Grawe, 1956) and hexahydrite ($MgSO_4 \cdot 6H_2O$). Because the iron analogs of these compounds have nearly identical diffraction patterns, the presence of magnesium was verified by a semiquantitative spectrographic analysis. The rare mineral starkeyite, also named lenohardtite by Berdesinski (1952), has been reported only from Madison County, Missouri (Grawe, 1945), from Empelde, near Hannover, and from Walthlingen, Germany (Berdesinski, 1952), and, more recently, from roof shales of coal seams in Buchanan, Dickenson, Lee, Tazewell, and Wise counties, Virginia (Meyertons, 1955). Vugs in the limestone exposed in the road cut a few feet from the quarry, are filled in some instances with milky quartz crystals while at other times they are lined with simple calcite rhombohedrons.

Other Occurrences of Celestite and Calciostrontianite in Virginia

Up to the present time celestite has also been found at three other localities in Virginia. With the discovery of the Wise County celestite, one of the writers (RSM) recalled that he had identified a small celestite sample brought to him by Mr. L. C. Rowan in 1955. An inquiry revealed that the sample came from a quarry at Hayfield, Frederick County. The writers visited the deposit and found much tabular lozenge-shaped celestite lining vugs (up to 8 inches across) in dolomite rock. Celestite crystals are up to ½ inch across. Some of the vugs are filled with alabaster gypsum. During the summer of 1959 one of the writers (RSM) discovered celestite in a float calcite cluster collected by Mr. E. K. Rader near Fulks Run, Rockingham County. A visit to this area revealed *in situ* celestite occurring as tiny crystals in small vugs and cavities.

Dietrich (1960) has recently reported calciostrontianite, with small amounts of celestite, in vugs and on joint surfaces in dolomite from south of Dublin, Pulaski County. He also observed calciostrontianite in vugs in a limestone drill core from near Harrisonburg, Rockingham County.

Economic Value of Strontium

Although the strontium discovered so far in Virginia probably is not of commercial value, future exploration may uncover richer deposits. The principal sources of supply of strontium are the United Kingdom and Mexico. Strontium chemicals and ore, imported into the United States, total about 28,000 tons annually.

According to Schreck and Arundale (1959) strontium is most often used in the form of compounds which are in demand in the field of pyrotechnics. The brilliant crimson glare given off by strontium when burned, and the fact that there have been no satisfactory substitutes to produce this effect for most pyrotechnical uses, accounts for its need in this field.

The strontium compounds most frequently used in pyrotechnics are the carbonate, chloride nitrate, oxalate, and peroxide. Large quantities of these are used each year in the manufacture of railway and truck signal flares, tracer ammunitions, and other signaling devices. Properties that strontium has in some compounds renders it useful in sugar refining and zinc refining, and in the manufacture of welding-rod coatings, depilatories, luminous paints, lubricants, electrical insulating materials, ceramics, and strontium chemicals.

Consumption of strontium minerals in raw form is much less than in compound form. Ground celestite has been used as a substitute for barite as a filler, particularly in colored paints, sealing compounds for electrical batteries, asphaltic mixtures, rubber, and sealing wax. It can be a weighing agent for well-drilling muds. Ground celestite and strontianite have been used in processes of purifying caustic soda for use by the rayon and paper industries. Strontianite has been used in open-hearth steel furnaces as a flux, producing a fluid and strongly basic slag which prevents damage to furnace linings. Especially advantageous are the desulfurizing and dephosphorizing properties of the process which are desirable in processing certain low grade iron ores. Because of the high quality of domestic iron ore, very little strontianite is being consumed in this manner in the United States.

Some strontium is used as an additive to lead, increasing the hardness and durability for use in storage batteries. In copper castings it has been found to increase the hardness and lessen blow holes. Strontium-tin, strontium-lead, strontium-aluminum, and other strontium alloys have been used in small quantities for purifying alloys and metals.

Acknowledgments

The writers wish to express their gratitude to Mr. G. H. Belton for his cooperation in allowing them to examine and collect from his quarry; and also for making all the specimens he and his son collected for several years available for study.

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New Publications

Rept. of Inv. 1. GEOLOGY OF THE LEXINGTON QUADRANGLE, VIRGINIA by K. F. Bick. 40 p., map. Price: $2.00

The rocks of the Lexington quadrangle, Virginia (bounded by parallels 37°45′ and 38°00′ and meridians 79°15′ and 79°30′) range in age from Precambrian to Middle Devonian. The metamorphic and igneous Precambrian basement is overlain by 2,500 feet of clastic rocks that contain intrebedded volcanic material in the basal part; these rocks, Precambrian and Early Cambrian in age, represent a westward transgression of a sea across the area. This sequence is overlain by 10,000 feet of Early Cambrian to Middle Ordovician rocks, chiefly carbonate rocks that represent a period of offshore shallow water deposition. The Middle Ordovician to Middle Devonian sequence is composed largely of clastic rocks about 4,500 feet thick; the lower half of this sequence is chiefly sandstone and the upper half is chiefly shale. These clastic rocks represent debris eroded from mountainous areas east of the Lexington quadrangle.

Deformation of the rocks of the Lexington quadrangle occurred during the Appalachian orogeny of Permian age. The area may be conveniently divided into 3 structural units which correspond closely to the physiographic divisions: the Blue Ridge belt is characterized by folding and faulting of the Precambrian basement rocks; the central belt is characterized by low angle overthrust faulting of sedimentary rocks; and the northwestern belt is characterized by folding of the sedimentary rocks. The Blue Ridge belt is in fault contact with the rocks of the central belt along the Midvale fault and the previously unmapped South River fault. The major thrust faults of the central belt are the North Mountain fault, the Pulaski fault, and the Pulaski-Staunton fault. The North Mountain fault divides into 3 branches in the northern part of the quadrangle and a large window in the upper plate is present southwest of Brownsburg. The Pulaski fault branches southwest of Fairfield; the west branch is continuous with the Staunton fault and is herein named the Pulaski-Staunton fault; the minor east branch, formerly thought to be the main Pulaski fault, is named the Fairfield fault. The major structures of the northwestern belt are folds; one fold is overturned and thrust northwestward along the previously unmapped Zack fault in the northern part of the quadrangle. The structural history is a record of long continued deformation that progressed from folding of sedimentary rocks to overthrust faulting of sedimentary rocks, and finally to faulting of the Blue Ridge anticlinorium over the earlier formed structures.

Iron ore and manganese ore have been mined in the quadrangle from residual accumulations overlying the Rome formation and the Ridgeley sandstone; undiscovered deposits may exist, but they are likely to be small. The quadrangle contains ample supplies of carbonate rocks that may be used for many industrial purposes.

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Min. Res. Rept. 1. SOURCES OF AGGREGATE USED IN VIRGINIA HIGHWAY CONSTRUCTION by Edwin O. Gooch, Robert S. Wood and William T. Parrott. 65 p., map.

Price: $0.75

Materials used for highway aggregate in Virginia range from highly metamorphosed rocks of Precambrian age to unconsolidated sand and gravel deposits of recent age. Limestone, dolomite and quartzite are produced in the Ridge and Valley province. Granite, various types of gneiss, diabase, basalt, marble, limestone, sandstone and conglomerate are produced in the Blue Ridge and Piedmont provinces. Sand and gravel are produced in the Coastal Plain province.

Aggregate is calssified into grades A, B and C on the basis of three physical properties: abrasion loss, specific gravity and absorption. Tests used in determining the physical properties are described in the text and the specifications for each grade are listed.

The name and location of each aggregate producer is given in the text and on the accompanying map. The geology of each pit and quarry is described, physical test data on the aggregate are listed with each description, and the size of the operation or rate of production during 1957 or 1958 is given.

News Notes of Virginia Mineral Producers

The first shipment of aplite was made on August 17, 1960, from Metal and Thermit Corporation's new ore processing plant at Beaverdam, Hanover County. The material was sold

to a major glass manufacturer. Metal and Thermit Corporation has mined rutile and ilmenite at the Hanover mine for two years and the aplite plant represents part of a program to obtain additional products from the associated minerals in the ore.

The Flintkote Company will acquire the assets of M. J. Grove Lime Company, Lime Kiln, Maryland in a merger plan which has been approved by the directors of both companies and is now subject to final approval by stockholders. In Virginia M. J. Grove operates an underground limestone mine half a mile northwest of Stephens City and a limestone and dolomite quarry 1½ miles west of Middletown, Frederick County.

The Roanoke-Webster Brick Co., Inc. has changed its name to Webster Brick Company. This company operates plants at Webster, Botetourt County, near Somerset, Orange County, and near Suffolk, Nansemond County and also in North Carolina.

Southern Materials Co., Inc., has acquired the quarry of the Superior Stone Co. near Rawlings in Brunswick County and a sand and gravel operation formerly owned by Bryan Rock and Sand Co. near Petersburg, Prince George County.

Clay dummies, which are used by the mining industry for tamping shot holes, are being produced by Tazewell Clay Products Co. at Tazewell, Tazewell County, and by the Combs Dummie Company near Clintwood, Dickenson County.

The Dominion Resources Development Co. is no longer operating its quarry in the Erwin quartzite at Waynesboro, Augusta County.

The Limestone Dust Corporation at St. Clair, Tazewell County utilizes limestone from Pounding Mill Quarry Corp. Quarry No. 2 in the production of powdered limestone for use as mine safety dust.

The Montgomery Lime Company has opened a new quarry approximately one mile west of Radford, Pulaski County for the production of crushed stone.

Acme Stone Co. Inc., Division of Lambert Brothers, opened a quarry near Abingdon, Washington County, in September 1959, for the production of crushed stone.

J. P. Dillard began production of sand and gravel at an operation half a mile west of Guinea, Caroline County, in September 1959.

W. E. Graham and Sons, Division of Vulcan Materials, has acquired the Greystone Quarries, Inc. quarry southeast of Boydton in Mecklenburg County.

Additions to Geologic Staff of Virginia Division of Mineral Resources

Mr. James (William) Smith, recently with the Georgia Department of Mines, Mining and Geology, joined the Division's staff after completing his graduate work at Emory University. His dissertation for the Master of Science degree is entitled "Geology of an Area along the Cartersville Fault," which was a study of the structure and stratigraphy of metamorphic and sedimentary rocks in the Piedmont province and Valley and Ridge province. After obtaining his Bachelor of Arts degree in geology from Emory University, he served with the United States Air Force for three years as a photo intelligence officer and as a pilot. He has had experience in geological explorations for a cement company. Mr. Smith is interested in the mineralogy and structure of Piedmont materials and is currently engaged in the geologic mapping of part of Fluvanna County. He is married and has a daughter, Linda Denise.

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Mr. James (Liehner) Ruhle comes to the Division after working part-time with the Academy of Natural Sciences of Philadelphia for ten years under the direction of Dr. Horace G. Richards. He obtained his Bachelor of Science degree in geology from the University of Pennsylvania and his Master of Science degree in geology from the University of Massachusetts. His dissertation, "The Mount Laurel and Wenonah Sands of New Jersey," includes grain size distribution studies and heavy mineral analyses. Mr. Ruhle is to assist in paleontologic studies for the Division. His major interest will be relegated to the stratigraphy and structure of the Coastal Plain province. He is married and has a son, Karl.

Topographic Mapping

Twenty-six new topographic maps issued for quadrangle areas in Virginia. Seven were completed under the State-Federal cooperative program to finance topographic mapping in Virginia. Costs of preparation of the maps issued under this program are shared equally by the Virginia Division of Mineral Resources and the United States Geological Survey, Topographic Branch. Nineteen maps were completed under federally financed programs of the Geological Survey (5 maps) and Tennessee Valley Authority (14 maps).

Quadrangle	Latitude	Longitude	Scale	Contour
Cooperative Program				
Crewe	37° - 37° 15'	78° - 78° 15'	1:62,500	20
Farmville	37° 15' - 37° 30'	78° 15' - 78° 30'	1:62,500	20
Jetersville	37° 15' - 37° 30'	78° - 78° 15'	1:62,500	20
Keysville	37° - 37° 15'	78° 15' - 78° 30'	1:62,500	20
Macks Mountain	36° 45' - 37°	80° 30' - 80° 45'	1:62,500	40
Mt. Airy	36° 30' - 36° 45'	80° 30' - 80° 45'	1:62,500	40
Pamplin City	37° 15' - 37° 30'	78° 30' - 78° 45'	1:62,500	20
United States Geological Survey, Topographic Branch				
Bland	37° - 37° 15'	81° - 37° 15'	1:62,500	40
Endicott	36° 45' - 37°	80° - 80° 15'	1:62,500	40
Floyd	36° 45' - 37°	80° 15' - 80° 30'	1:62,500	40
Herndon	38° 52' 30" - 39°	77° 22' 30" - 77° 30'	1:24,000	10
Metomkin Inlet	37° 37' 30" - 37° 45'	75° 30' - 75° 37' 30"	1:24,000	10
Tennessee Valley Authority				
Big A Mountain	37° - 37° 07' 30"	82° - 82° 07' 30"	1:24,000	40
Big Stone Gap	36° 45' - 36° 52' 30"	82° 45' - 82° 52' 30"	1:24,000	40
Caney Ridge	37° - 37° 07' 30"	82° 22' 30" - 82° 30'	1:24,000	40
Dungannon	36° 45' - 36° 52' 30"	82° 22' 30" - 82° 30'	1:24,000	20
East Stone Gap	36° 45' - 36° 52' 30"	82° 37' 30" - 82° 45'	1:24,000	20
Fort Blackmore	36° 45' - 36° 52' 30"	82° 30' - 82° 37' 30"	1:24,000	20
Middlesboro South	36° 30' - 36° 37' 30"	83° 37' 30" - 83° 45'	1:24,000	20
Moll Creek	36° 45' - 36° 52' 30"	82° 15' - 82° 22' 30"	1:24,000	20
Norton	36° 52' 30" - 37°	82° 37' 30" - 82° 45'	1:24,000	20
Pound	37° - 37° 07' 30"	82° 30' - 82° 37' 30"	1:24,000	40
St. Paul	36° 52' 30" - 37°	82° 15' - 82° 22' 30"	1:24,000	40
Toms Creek	36° 52' 30" - 37°	82° 22' 30" - 82° 30'	1:24,000	20
Wheeler	36° 30' - 36° 37' 30"	83° 30' - 83° 37' 30"	1:24,000	20
Wise	36° 52' 30" - 37°	82° 30' - 82° 37' 30"	1:24,000	20

Division of Mineral Resources
Box 3667
Charlottesville, Virginia

Form 3547 Requested

Petrochemical Plants in Virginia

Allied Chemical Corp.
61 Broadway
New York 6, N. Y.
Plant: Nitrogen Division, Hopewell, Va.
Raw Material: Natural Gas
Products: Ammonia (1100 tons per day), ammonium nitrate-limestone, pebbled ammonium nitrate, nitrogen solutions, sodium nitrate, and nitrogen tetroxide.
Construction: Expansion here reportedly includes caprolactam facilities.

American Oil Co.
555 Fifth Ave.
New York 17 ,N. Y.
Plant: Yorktown, Va.
Raw Material: Refinery streams
Products: Polybutenes and sulfur (50 tons per day)

Dow Chemical Co.
Midland, Michigan
Plant: Williamsburg, Va.
Product: Zefran acrylic fiber (12,000,000 lb. per year)
Construction: Nylon 6 facilities (12,000,000 lb. per year) scheduled for completion late 1961.

Firestone Synthetic Fibers Co.
Division of Firestone Tire & Rubber Co.
Akron 17, Ohio
Plant: Hopewell, Va.
Product: Polypropylene

(Source: "Oil and Gas Journal," September 5, 1960)

Topographic Map of Rockingham County

Portions of eleven topographic maps of the Virginia Quadrangle Map Series were combined to make the "Topographic Map of Rockingham County." These maps are printed to aid in the possible establishment of industries, plants, housing developments, etc. The map has been printed on a scale of 1:62,500 or 1 inch equals approximately 1 mile, contour interval of 20, 40, and 50 feet, and a size of 42 x 50 inches. The price of this map is $1.50.